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Method and Apparatus for storing or transmitting coding parameters separately from coded audio-visual data

The invention relates to a method and to an apparatus for
5 storing and transmitting coding parameters separately from
coded audio-visual data.

Background

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In the field of compressing audio-visual (AV) data the technological trend goes towards increasingly parameter-oriented descriptions. Seen from an encoding point of view, compression parameters in general specify, in which of several possible modes certain parts of the encoder input (AV data) shall be processed. Correspondingly, from a decoding point of view, those same compression parameters indicate, according to which of several allowable rules a section of a given compressed bit stream shall be converted back into a piece 20 of AV data. Compression parameters can be of different nature; assuming a compression scheme where pictures are subdivided into slices, they may be "global parameters (GP)", "picture layer parameters (PLP)" and "slice layer parameters (SLP)". It is expected that GP are mostly constant, since 25 they express parameters such as picture size or color space. However, they could be changed at the start of a random access unit, such as a GOP. Therefore, a small set of different GP sets will be referenced from within an AV bit stream. PLPs express parameters that might change more frequently, 30 at a maximum on a per-picture basis. Hence, each coded picture will reference one out of a potentially larger set of such PLPs. Similarly, different SLPs could be referenced by each coded slice within a coded picture. It is expected that GP are mostly predetermined by the nature of the specific AV 35 material being compressed, whereas PLP and SLP can be freely chosen as part of the encoder optimization. For the latter,

the selection is likely to be based on some kind of compression efficiency measure quantifying either the coding error or the compression bit rate or both. The above-mentioned technology will be used in the developing MPEG-4 Part 10,
5 also known as H.26L or JVT codec.

Invention

10 The invention is based on the recognition of the following facts.

In addition to specifying and appropriately selecting the compression parameters, they themselves must in most cases
15 be transmitted or stored along with the AV data proper, in order to allow a meaningful decoding. This task needs to be tackled separately for each application domain, wherein the transmission or storage of compression parameters has to fulfil several, partly conflicting requirements.

20 • Compactness:

On a global as well as local level, compression parameter description must be kept compact, such that the total bandwidth needed for AV plus parameters does not outweigh any gain in compression efficiency achieved by a parameterized
25 approach. This includes a strong motivation to avoid any unnecessary repetition or other redundancy present in the compression parameters.

Consequently, the indexing mechanism from a coded picture or slice to the parameter set(s) will limit the number of parameter sets of each type that can be addressed, in order to reach the compactness goal. Hence, it must be specified whether or when it is possible that two different parameter sets are identified by the same parameter set identifier (numeric or other label). In other words, a name scope for
35 the parameter set identifiers needs to be established.

• Decodability:

With AV data, especially on a storage medium, being prone to be accessed in non-sequential, random ways, any parameter set allocation scheme must ensure that all required compression parameters are made available when entering and decoding a bit stream at any of its entry points. This includes the important cases of any kind of trick play, and may entail allowing certain controlled forms of data redundancy.

5 • Compatibility:

When designing an extension of an existing specification, 10 such as DVD for optical storage, it is desirable to maintain as many as possible of the well-understood and established system concepts. Solutions taking this into account are likely to be judged favorably in the standardization process.

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Therefore, a problem to be solved by the invention is to store/transmit compression parameter sets optimized for bit rate and compatibility to the logical structures used in the application domain.

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This problem is solved by the method disclosed in claim 1. An apparatus that utilizes this method is disclosed in claim 9. A corresponding decoding method and apparatus is claimed in claim 10 and 11, respectively.

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According to the inventive method a number of compression parameter sets being referenced from within the coded data used. The compression parameter sets are stored in auxiliary data files that are uniquely associated to the file or 30 stream containing the main AV bit stream. Identifiers of the compression parameter sets and the corresponding references to these identifiers in the main AV bit stream are unique within said auxiliary data files and associated file or stream containing the main AV bit stream.

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Advantageously, the existing auxiliary data files related to

the file or stream containing the main AV bit stream are extended to carry the compression parameter sets.

Advantageously, an additional isomorphic set of auxiliary data files for said file or stream containing the main AV bit stream is created to carry additional information such as said compression parameter sets, as to not sacrifice compatibility with older equipment not being able to process extensions to existing auxiliary data files.

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Furthermore, it is of advantage that the validity period of said compression parameter set identifiers is explicitly signalled.

15 Advantageously, the signalling of the validity period of the compression parameter set identifiers is based on the presentation or decoding time information associated to portions of the main AV bit stream. However, the signalling of the validity period of the compression parameter set identifiers 20 may also be based on the file names associated to portions of the main AV bit stream. Also, the signalling of the validity period of the compression parameter set identifiers may be based on an existing identification of the underlying 25 transport or storage entities, such as packets or sectors, associated to portions of the main AV bit stream carried therein.

According to a further advantageous embodiment 30 the compression parameter sets are referenced indirectly, wherein

- a. the parameter set identifiers in the AV bitstream of each of a set of parts of AV material are defined to refer to entries of a secondary table;
- b. the secondary table is individually available per each 35 part, and is stored in auxiliary files in a data structure which is repeated per each part;

c. entries of all secondary tables of said AV material are defined to be themselves identifiers referring in turn to entries of a common parameter set table provided once per said AV material.

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Further advantageous embodiments of the invention result from the following description.

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Drawing

Exemplary embodiments of the invention are described with reference to the accompanying drawings, which show in:

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- Fig.1 an AV stream with separate parameter sets;
- Fig.2. an AV stream with out-of-band parameter sets modelled after the AV data;
- Fig.3. the internal structure of PGCI Files existing in DVD;
- Fig.4. the internal structure of PGCI Files extended to encompass parameter sets;
- Fig.5. the internal structure of PGCI File and a parallel File to encompass parameter sets ;
- 20 Fig.6. parameter Sets with Scope Period information added;
- Fig.7. an indirect referencing mechanism.

Exemplary embodiments

30 For video compression schemes such as MPEG-4 Part 10, compression parameter sets are generated during the video encoding process, are stored separate from the main AV bit stream and then are being referenced from there, as shown in Figure 1. An individually accessible data unit (IADU) of an AV stream with separately generated parameter sets comprises pictures p1, p2, p3, pi,... each subdivided into slices s1, s2,..., sn. For the slices there are pointers to separately

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generated compression parameters, exemplarily, to global parameters GP1 and GP2, picture layer parameters PLP1, PLP2 and PLP3, and slice layer parameters SLP1, SLP2, SLP3, SLP4 and SLP5.

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The IADU commonly starts with an entry picture p1 (intra-coded frame) that is decodable independent from any other data in the AV bit stream, with the exception of the reference to the needed parameter sets, e.g. one reference each 10 to a global parameter GP1, a picture layer parameter PLP1 and slice layer parameters SLP1, SLP2 for each coded slice within the picture.

As depicted in Figure 2 compression parameter sets are 15 stored out-of-band, i.e. in a file or set of files separate from the main AV file (equivalently: to transmit the parameter sets separately and prior to any subsequent transmission of AV data). Exemplarily shown are two IADUs with the AV 20 data AV_IADU_1 of the first IADU and AV_IADU_2 of the second IADU. The parameter sets are located out-of-band with parameter sets PS_{p1} referenced in entry picture p1 of IADU 1 followed by parameter sets PS_o referenced in other pictures of IADU 1. Also shown are parameter sets PS_n referenced in 25 none of the IADUs and parameter sets PS_IADU_2 referenced in IADU 2.

Preferably, the internal structure of such a parameter set 30 file/stream should closely follow that of the AV data it is related to, as shown in Figure 2. Typically, the parameter set identifiers must remain unique within an "encoding session". In other words, the same identifier cannot be used 35 for two different parameter sets within the encoding session. Hence, the encoding session constitutes the scope of these identifiers.

An "encoding session" is mapped to meaningful entities on a

storage medium, such as DVD, as follows: DVD identifies a hierarchy of semantic entities, among them "Program Chain", "Cell" and "Video Object Unit (VOBU)". In order to minimize unnecessary repetition of parameter sets, the scope of the 5 parameter set identifiers is limited to the biggest possible of these entities. In DVD, Information about entities constitutes part of Navigation Data, and is assembled in the "Video Manager Information (VMGI)" and "Video Title Set Information (VTSI)" files, to be commonly called PGCI files 10 hereafter. Figure 3 shows the internal structure of these PGCI files.

Furthermore, either the PGCI files may be extended as defined in DVD by including the compression parameter sets directly in them (Figure 4) or, advantageously in order to 15 maintain compatibility with existing DVD players, to create separate files with an internal structure analogous to that of the PGCI files but just containing the compression parameter sets (Figure 5).

20 During authoring, different parts of a Program Chain may have been encoded separately prior to recording on a storage medium. In that case, it is very likely that, between these parts, the same parameter set identifier happens to be assigned 25 to different parameter sets. In order to support easy authoring of such compound content, explicit identification about the scope period of the parameter set identifiers may be added. It is not a good option to add such identification to the AV bit stream where compression parameter sets are 30 being referenced, since that would require more parsing of the bit stream and would increase the bit rate. Therefore, it is proposed to amend each compression parameter set or groups of such parameter sets as stored in out-of-band files 35 with information specifying its scope period (Figure 6). Such scope period information can be based on the time stamps within the AV material, on file names identifying

different parts of the AV bitstream (VOB files on DVD), or on sector numbers on the disc.

In cases of compound content as described above, although parameter set identifier assignment is likely to vary between separately encoded parts of an overall AV material, it is nevertheless likely that many if not all of these parameter sets, despite bearing different identifiers, are actually identical; since the employed encoding equipment may internally use and choose from a limited set of predefined parameter sets. In this case, as another way to avoid unnecessary repetition of compression parameter sets, it is additionally proposed to employ an indirect mechanism of referencing parameter sets, where the parameter set identifiers in the AV bitstream of each part are defined to be referring to a small secondary table individually available per each part, where this secondary table is stored in the out-of-band files in a data structure which is repeated per each part, and where the entries of all the secondary tables of the overall AV material are defined to be themselves identifiers referring in turn to entries of a common parameter set table provided once (Figure 7).

The invention has the advantage of ease of formatting authored AV bitstreams onto a storage medium as well as bit rate efficiency. It is expected that authoring tools will store the parameter sets separate from the bit stream of AV data, as this is the original goal of the usage of parameter sets. Each parameter set needs only be stored once and can be referenced multiple times from any coded picture on the storage medium. Employing an indirect referencing scheme, parameter set management remains efficient even if AV assets come from heterogenous sources.

The invention is especially useful for transport or storage of AV bit streams. However, the invention is also applicable

to other kinds of bit streams.